A SEARCH FOR OBSCURED GLOBULAR CLUSTERS

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ABSTRACT. It has been estimated that up to several tens of globular clusters in our Galaxy remain undiscovered, because they are hidden by the dust. Most of those clusters are expected to be in the bulge area, but some may be anywhere in the galactic plane. This search is based on the use of *IRAS* catalogs as candidate lists for the obscured globular clusters. It was found that the properties of detected known clusters are sufficiently distinct for a meaningful sifting through the PSC. A sequence of statistical "filters", described below, was applied on the PSC, until a couple of hundred most promising candidates were found in the bulge.

So far, only the Point-Source Catalog (PSC) has been analysed; it is expected that even better chances of finding clusters will be afforded by the use of Small Extended Sources Catalog. First, known globular clusters were identified in the PSC, dubious or confused sources rejected, and the statistics of their *IRAS* properties established. The full PSC contains 245839 sources, and a selection procedure must be devised to extract a manageable number of cluster candidates.

The first step was to define the Galactic bulge and plane search area. The bulge area was defined as: $345° \geq l_{II} \leq 15°$, $-8° \geq b_{II} \leq 8°$. The plane area spans the rest of the Galactic equator, with $-2° \geq b_{II} \leq 2°$, except for the region $330° \geq l_{II} \leq 30°$, where the thickness is $-4° \geq b_{II} \leq 4°$. These two regions contain 71482 sources, out of which 60886 are unidentified, and 5956 are classified as multiple. Out of the unidentified, 1500 were subsequently identified with SAO stars. This leaves the total search sample of 60214 sources.

It was imediately noticed that all known globular clusters identified in the PSC are detected in the 12 μm band, and none are detected in the 60 and 100 μm bands. This is as expected, since we are expecting to find stars, rather than hot dust or gas. Applying the corresponding selection to the previous sample resulted in 36229 sources. At this point, it was decided to search the bulge area first, since that is where most of the missing clusters are expected to be, and to postpone the analysis of the galactic plane sample. The bulge sample as selected so far consists of 13837 sources.

Examination of $\log F_{12}$ histograms, for the PSC and the known bulge clusters indicated that the probability of finding a cluster is higher for the fluxes exceeding $\sim$ 2 Jy in this band. This is as expected: the core of a globular cluster contains many giants, whereas most of the field PSC sources are probably individual stars.

J. E. Grindlay and A. G. Davis Philip (eds.),
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This flux selection narrowed the sample down to 5018 sources. Examination of F_{25}/F_{12} histograms indicated that the clusters are never too cold, and an empirical threshold was imposed to this ratio, $F_{25}/F_{12} \leq 1.4$ for F_{25} detections, or ≤ 1.2 for F_{25} upper limits. This further reduced the sample to 4584 sources. From the log F_{25} histograms, it appears that the clusters avoid the range $F_{25} \sim 1.5 - 3$ Jy. This may be a spurious effect, but it is possible that the bimodality reflects a true distinction between clusters with and without much dust, or post-AGB stars. Application of this exclusion criterion lowered the sample to 2539 sources.

Some meager spatial resolution information is provided in the PSC in the form of correlation coefficients (CC) : 1=A=stellar, 2=B=slightly diffuse, etc. Not surprisingly, the clusters are much more often classified as diffuse (CC > 1). The contrast in CC distributions between the known clusters and the PSC sources increased after the rejection of "faint" and "cold" sources in the three steps above. Selecting only the sources with both CC(12μm) > 1, and CC(25μm) > 1, yielded the sample of primary candidates, consisting of 70 sources; the sample of objects where CC(12μm) > 1, or CC(25μm) > 1, but not both, is the sample of secondary candidates, consisting of 318 sources. If the F_{25} exclusion described above is relaxed, then there are additional 298 marginally extended candidates.

An examination of candidate fields on the ESO/SERC IR sky survey films is now in progress. A number of candidates can be immediately associated with obvious stars, and the remaining ones, mostly "blank fields", will be imaged with a CCD in R and I at CTIO.

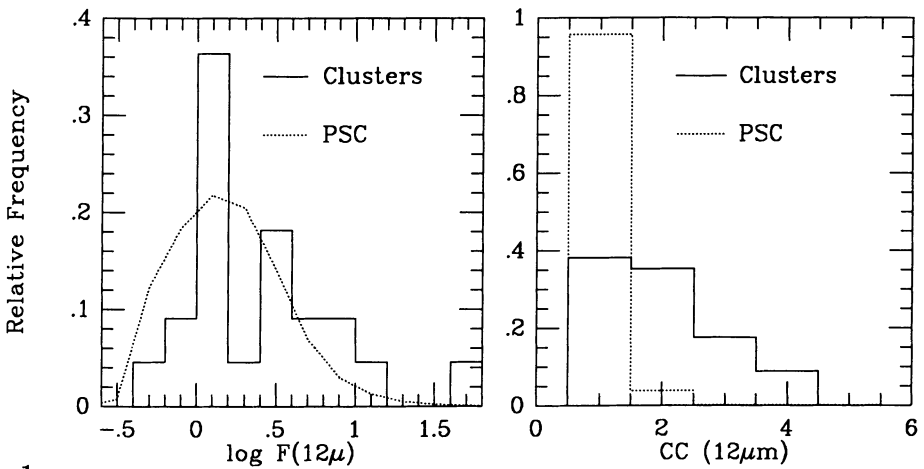

Fig. 1.

Left: Relative frequency distributions of log F_{12} for the bulge globular clusters detected by IRAS, and the "hot" PSC sources, in 0.2 log bins. Above $F_{12} \simeq 2$ Jy, the clusters dominate. Similar selection criteria can be devised based on the 25μm fluxes, and flux ratios.

Right: Distributions of angular resolution flags (correlation coefficients), given as ranks, 1 for a pointlike source, 2 for a slightly diffuse, etc., for the globular clusters, and the PSC sources, after the flux and flux ratio filters were applied. The clusters show a much higher tendency to be marginally resolved.